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EXPLORING SILENT HEART ATTACKS IN TYPE 2 DIABETES PATIENTS FACTORS INFLUENCING OCCURRENCE, BHAGALPUR: A CROSS-SECTIONAL STUDY AT HOSPITALS.

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ABSTRACT
Background
No chest pain or breathlessness characterizes silent myocardial infarctions (SMIs). These asymptomatic events are especially concerning for type 2 diabetics (T2DM), who are at higher risk for cardiovascular disease. The study investigated the prevalence and factors associated with silent myocardial infarction in asymptomatic Type 2 Diabetes Mellitus patients, focusing on abdominal obesity, glycemic control, and gender during treadmill testing.

Methods
The cross-sectional study included 35 asymptomatic T2DM patients aged 40-60, with no clinical evidence of coronary artery disease. Data collection involved detailed medical history, clinical examination, resting ECG, and laboratory investigations. Participants underwent treadmill testing, with the procedure stopped if symptoms occurred. Statistical analysis was done, with significance set at $p < 0.05$.

Results
The mean age of participants was 52.6 ± 6.8 years, with 51.4% being male. Abdominal obesity was present in 60% of the individuals. Symptoms such as chest pain or shortness of breath occurred in 22.9% during treadmill testing. A significant correlation was found between abdominal obesity and symptoms ($p = 0.043$), whereas gender was not significantly related ($p = 0.321$). Mean lab results showed: HbA1c 7.3% (± 0.8), FBS 155.2 mg/dL (± 40.6), and total cholesterol 210.5 mg/dL (± 45.9). No significant difference in mean HbA1c levels was found between symptomatic and asymptomatic subjects ($p = 0.179$).

Conclusion
The study highlights the significant prevalence of silent myocardial ischemia in asymptomatic T2DM individuals, with abdominal obesity being a notable risk factor for symptom occurrence during treadmill testing. Glycemic control, as indicated by HB1AC levels, did not show a direct influence on symptom presentation during exercise stress testing.

Recommendations
Regular screening for silent myocardial ischemia is suggested for asymptomatic T2DM patients, especially those with abdominal obesity. To prevent silent heart attacks in this high-risk population, weight control, and lifestyle changes should be prioritized.

Keywords: *Type 2 Diabetes Mellitus, Silent Myocardial Ischemia, Abdominal Obesity, Glycemic Control, Treadmill Testing*
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INTRODUCTION
Silent heart attacks, also well-known as silent myocardial infarctions (SMIs), are heart attacks that occur without the typical symptoms associated with heart attacks, such as severe chest pain, shortness of breath, or sweating. These asymptomatic events are of significant concern, particularly in individuals with type 2 diabetes mellitus (T2DM), who are at a greater risk for cardiovascular diseases, including SMIs.

T2DM is a metabolic disease that affects millions of people globally and is characterized by insulin resistance and hyperglycemia. The risk of cardiovascular illnesses, such as heart failure, coronary artery disease, and myocardial infarctions, is known to be elevated by T2DM [1]. SMIs are of special concern among these because they frequently remain undiagnosed and, thus, untreated, increasing the risk of subsequent heart attacks and mortality.

Several factors contribute to the increased occurrence of SMIs in individuals with T2DM. One primary factor is diabetic neuropathy, a common complication of diabetes that affects the nerves, including those responsible for transmitting pain signals from the heart. As a result, patients with diabetic neuropathy may not experience the typical chest pain associated with heart attacks, leading to silent events [2]. Additionally, T2DM is often associated

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with other conditions such as hypertension and hyperlipidemia, which further increase the risk of cardiovascular events, including SMIs.

Silent heart attacks are also largely caused by endothelial dysfunction and chronic inflammation, both of which are frequently observed in T2DM. Advanced glycation end products (AGEs) are produced when diabetes patients experience prolonged hyperglycemia; these products incite oxidative stress and inflammation [3]. These processes contribute to atherosclerosis, the buildup of plaques in the arteries, which can rupture and cause myocardial infarctions. In the context of SMIs, the lack of typical symptoms can be attributed to the gradual and diffuse nature of plaque buildup, which may not trigger acute pain responses [4].

Furthermore, resistance to insulin and hyperinsulinemia in T2DM patients contribute to the development of coronary artery disease. Insulin resistance leads to a pro-inflammatory and pro-thrombotic state, increasing the risk of plaque formation and subsequent silent infarctions. Additionally, lifestyle factors such as poor diet, sedentary behavior, and smoking, which are prevalent in many T2DM patients, further exacerbate cardiovascular risk [5].

Silent heart attacks are a significant concern for patients with T2DM, driven by a combination of diabetic neuropathy, chronic inflammation, endothelial dysfunction, and lifestyle factors. Understanding these factors is crucial for developing targeted strategies to prevent and manage SMIs in this high-risk population.

The study aimed to investigate the prevalence and factors associated with silent myocardial infarction among asymptomatic Type 2 Diabetes Mellitus patients, focusing on the influence of abdominal obesity, glycemic control, and gender on symptom occurrence during treadmill testing.

METHODOLOGY

Study Design

A hospital-based cross-sectional investigation.

Study Setting

The research was conducted at Jawahar Lal Nehru Medical College, Bhagalpur, Bihar, India, from May 2023 to June 2024.

Participants

A total of 35 participants were included in the study.

Inclusion and exclusion criteria

Asymptomatic T2DM patients aged 40-60 years, of any gender, without clinical evidence of coronary artery disease were included. Patients with previous myocardial infarction, heart failure, angina pectoris, anemia, hypertension, renal disease, or specific ECG abnormalities were excluded. Additionally, individuals with chronic illnesses such as cancer, End-Stage Renal Disease (ESRD), or liver disease were excluded.

Bias

Efforts were made to minimize bias through careful participant selection and standardized procedures.

Variables

Variables included demographic data, medical history, BMI classification, abdominal obesity, and results from various diagnostic tests.

Sample size

To calculate the sample size for this study, the following formula was used for estimating a proportion of a population:

$$n = \frac{Z2 \times p \times (1-p)}{E2}$$

Where:

- n = sample size
- Z = Z-score corresponding to the desired level of confidence
- p = estimated proportion in the population
- E = margin of error

Data Collection

Data collection involved detailed medical history, clinical examination, resting ECG, and relevant laboratory investigations including RFT, CBC, HB1AC, Lipid Profile, FBS, and Complete Urine Examination.

Procedure

Participants were instructed to report to the hospital clinics after an overnight fasting period for treadmill testing. Smokers and alcohol consumers were advised to abstain from smoking and alcohol consumption on the morning of the investigation. Treadmill testing was performed using a standard protocol, and the procedure was stopped if participants experienced chest pain or shortness of breath.

Statistical Analysis

Using the Chi-square test, categorical variables were analyzed and presented as percent and frequency. Continuous variables were subjected to an independent sample t-test analysis and were represented as mean and standard deviation. At $p < 0.05$, statistical significance was established. The software EPI INFOTM version 7.2.1.0 was used for the analysis.

Ethical considerations

The study protocol was approved by the Ethics Committee and written informed consent was received from all the participants.

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RESULT

Table 1: Demographic and clinical profile

Factor	Values
Abdominal Obesity	
- Yes	21 (60.0%)
- No	14 (40.0%)
Symptoms during Treadmill Test	
- Present	8 (22.9%)
- Absent	27 (77.1%)
Gender	
- Male	18 (51.4%)
- Female	17 (48.6%)
Body Mass Index (BMI)	
- Normal (18.5 – 22.9)	7 (20.0%)
- Overweight (23 – 24.9)	16 (45.7%)
- Obese (25 -29.9)	12 (34.35%)
Mean Glycated Hemoglobin (HB1AC)	7.2 ± 0.6
Mean Fasting Blood Sugar (FBS)	148 ± 35.2 mg/dL
Mean Total Cholesterol	203 ± 41.5 mg/dL

The study comprised 35 asymptomatic T2DM patients, with a mean age of 52.6 years (± 6.8). The age range spanned from 40 to 60 years. Among the participants, 18 (51.4%) were male, and 17 (48.6%) were female, indicating a relatively balanced gender distribution within the cohort.

Participants' Body Mass Index (BMI) distribution revealed that 16 individuals (45.7%) were classified as overweight (BMI: 23 – 24.9 kg/m²), 12 individuals (34.35%) fell into the obese category (BMI: 25 -29.9 kg/m²), and 7 individuals (20%) had a normal BMI (BMI: 18.5 – 22.9 kg/m²).

Abdominal obesity, defined by a waist circumference exceeding 90 cm in men and 80 cm in women, was prevalent among 21 participants (60%) within the study cohort.

Table 2: Laboratory results

Laboratory Parameter	Mean ± SD	p-value	Confidence Interval (95%)	Odds Ratio
Glycated Hemoglobin (HB1AC)				
- Positive	7.3 ± 0.8	0.179	6.9 – 7.7	1.15
- Negative	7.1 ± 0.5		6.8 – 7.4	0.87
Fasting Blood Sugar (FBS) (mg/dL)				
- Positive	155.2 ± 40.6	0.150	140.5 – 169.9	1.12
- Negative	145.7 ± 32.1		133.1 – 158.3	0.89
Total Cholesterol (mg/dL)				
- Positive	210.5 ± 45.9	0.210	192.5 – 228.5	1.18
- Negative	198.3 ± 38.7		183.5 – 213.1	0.82
Renal Function Test (RFT) (mg/dL)				
- Positive	1.2 ± 0.3	0.110	1.1 – 1.3	1.10
- Negative	1.1 ± 0.2		1.0 – 1.2	.090
Complete Blood Count (CBC) (g/dL)				
- Positive	12.8 ± 2.5	0.140	11.5 – 14.1	1.11
- Negative	13.1 ± 2.1		11.0 – 15.2	0.89
Lipid Profile (mg/dL)				
- Positive	220.5 ± 50.2	0.250	198.1 – 242.9	1.16
- Negative	205.6 ± 40.7		184.9 – 226.3	0.84

This table provides detailed laboratory results, including the mean values, standard deviations, p-values, confidence intervals, and odds ratios for various tests performed on the study participants.

The mean values for laboratory parameters were as follows: Glycated Hemoglobin (HB1AC) – 7.3% (± 0.8), Fasting Blood Sugar (FBS) – 155.2 mg/dL (± 40.6), and total cholesterol – 210.5 mg/dL (± 45.9).

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During treadmill testing, 8 participants (22.9%) reported experiencing chest pain or shortness of breath, leading to the cessation of the procedure.

The Chi-square test showed a significant relation between abdominal obesity and the occurrence of symptoms during treadmill testing (p = 0.043), indicating that participants with abdominal obesity were more likely to experience symptoms during the test. However, no significant associations were found between gender and the occurrence of symptoms during testing (p = 0.321).

Independent sample t-tests displayed no significant variances in mean HB1AC levels between participants who experienced symptoms during treadmill testing and those who did not (p = 0.179), suggesting that glycemic control may not directly influence symptom presentation during exercise stress testing in this cohort.

DISCUSSION

The study included 35 asymptomatic T2DM patients, with a relatively balanced gender distribution. The majority of participants were overweight or obese, with 60% exhibiting abdominal obesity. Laboratory parameters indicated moderate levels of glycated hemoglobin, fasting blood sugar, and total cholesterol among the cohort.

During treadmill testing, 22.9% of participants reported experiencing chest pain or shortness of breath, leading to test cessation. Statistical analysis revealed a significant association between abdominal obesity and symptoms during treadmill testing (p = 0.043), suggesting that participants with abdominal obesity were more likely to experience symptoms. However, gender was not significantly associated with symptom occurrence during testing (p = 0.321).

There were no significant variances in mean glycated hemoglobin levels between participants who experienced symptoms during treadmill testing and those who did not (p = 0.179), indicating that glycemic control may not directly influence symptom presentation during exercise stress testing in this cohort.

Recent research has shed light on the incidence and risk factors associated with SMI in individuals with T2DM, underscoring the need for improved screening and management strategies.

According to one study, people with T2DM have higher rates of SMI than those with T1DM. Older age, a lower left ventricular ejection fraction, and carotid atherosclerosis were found to be significant risk factors. It's interesting to note that the existence of microvascular problems did not raise the likelihood of SMI in these patients, suggesting that other cardiovascular variables may be more important [6].

A further study highlighted the usefulness of exercise stress tests (EST) in identifying SMI in individuals with T2DM who do not exhibit any symptoms. This is especially true for patients who have other atherogenic risk factors, such as smoking, hypertension, PVD, hyperlipidemia, and peripheral vascular disease. According to the data, the incidence of SMI rises with the number of atherogenic risk factors, which suggests that EST is a useful screening technique in these high-risk individuals [7].

According to a large cohort study, maintaining specific risk factors within target ranges can greatly reduce or perhaps eliminate the increased risk of heart disease in people with T2DM. These variables include blood pressure, albuminuria, smoking status, glycated hemoglobin levels, and low-density lipoprotein cholesterol levels. When compared to the general population, patients who kept all five variables within goal limits had no appreciable additional risk of death, myocardial infarction, or stroke [8].

In T2DM patients, undiagnosed cardiovascular disease was brought to light via a review. It implies that a sizable portion of these patients experience cardiovascular illnesses that go undetected as they don't exhibit typical symptoms. This emphasizes how crucial early diagnosis and treatment are to avert problems and enhance patient outcomes [9].

The research looked at the relationships between SMI, peripheral or autonomic neuropathies, and survival in individuals with T2DM who did not have cardiovascular symptoms. It was discovered that microalbuminuria, glycemic control, and myocardial ischemia all had a substantial impact on survival, pointing to the need for an all-encompassing therapeutic strategy to effectively manage these patients [10].

Generalizability

These findings suggest that regular screening for abdominal obesity and comprehensive cardiovascular risk assessments should be prioritized in asymptomatic T2DM patients. While good glycemic control remains important, additional focus on managing abdominal obesity and other risk factors can help in the early detection and prevention of silent myocardial infarctions, improving patient outcomes on a larger scale.

CONCLUSION

The study underscores the significant influence of abdominal obesity on symptom occurrence during treadmill testing among asymptomatic T2DM patients. Gender was not found to be a significant predictor of symptom presentation. Additionally, glycemic control, as indicated by glycated hemoglobin levels, did not directly impact symptom manifestation during exercise stress testing. These findings highlight the complex interplay of metabolic and clinical factors in determining cardiovascular risks in diabetic patients, necessitating further research for more targeted preventive strategies.

Limitations

The limitations of this study include a small sample population who were included in this study. Furthermore, the lack of a comparison group also poses a limitation for this study's findings.

Recommendations

Regular screening for SMI in asymptomatic T2DM patients, especially those with abdominal obesity, is recommended. Comprehensive management strategies addressing weight control and lifestyle modifications should be emphasized to lower the risk of silent heart attacks in this high-risk population.

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List of abbreviations

SMI: Silent Myocardial Infarction
T2DM: Type 2 Diabetes Mellitus
BMI: Body Mass Index
ECG: Electrocardiogram
HB1AC: Glycated Hemoglobin
FBS: Fasting Blood Sugar
CBC: Complete Blood Count
RFT: Renal Function Test
EST: Exercise Stress Test
PVD: Peripheral Vascular Disease
AGEs: Advanced Glycation End Products
ESRD: End-Stage Renal Disease

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Conflict of interest

The authors have no competing interests to declare.

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